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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/920,978	08/01/2001	Shane J. Trapp	MI22-1674	6594

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EXAMINER	
BLUM, DAVID S	
ART UNIT	**PAPER NUMBER**
2813	

DATE MAILED: 09/07/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/920,978	TRAPP, SHANE J.	
	Examiner	Art Unit	
	David S Blum	2813	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *25 August 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *8,9,14-16,21 and 47-49* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *8,9,14-16,21 and 47-49* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

This action is in response to the amendment filed 08/25/04.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 8-10, 14-16, 21, 48-49 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wolf (pages 40, 52-54, and 555-557) in view of Ding (US 5,814,563), JP 200-349071, Sugishima (US4352724) and Lyons (US005930645A) or May (US005943585A).

Wolf teaches all of the positive steps of claims 8-10, 14-16, 21, 48-49 except for the use of ammonia as the source of hydrogen and various and multiple fluorocarbons, hydrocarbons, chlorofluorocarbons and chlorohydrocarbons, the fluorocarbons consisting of one of C4F6 and C5F8 and the volumetric ratio of all fluorocarbons to ammonia being from 40:1 to 20:1 and etching through the silicon nitride layer, oxide material and into a semiconductive material using a single etch chemistry.

Wolf (page 40 volume 2 teaches etching a trench (page 52 shows a plurality of trenches, thus the mask had a plurality of trench openings as in claim 49 in a semiconductor by etching through a patterned mask of pad oxide, silicon nitride layer and photoresist, and into the silicon substrate. Wolf also teaches (pages 555-557 volume 1) anisotropic plasma etching as in claim 10) through the mask and into the substrate using a dry etch of CF4 gas (as in claim 16) and that the shape of the trench (result of etch selectivity) can be altered by adjusting the fluorine-to-carbon ratio with hydrogen additions and altering the etch chemistry to make the etchant more selective toward the photoresist. Wolf teaches the chlorofluorine gas for etching nitride, silicon oxide, and silicon. Wolf (pages 52-54) teaches etching a trench in a bulk semiconductor using fluorocarbons, the mask openings to form a plurality of trench isolations.

Regarding the limitation of etching through the silicon nitride layer, oxide material and into a semiconductive material using a single etch chemistry, it is unclear whether Wolf uses the same etch chemistry or changes it for the substrate. Lyons teaches etching the silicon nitride (silicon oxy-nitride) layer, silicon oxide layer, and substrate in a single etch (column 6 lines 42-45). The plasma would be generated within the reaction chamber (where ever the gasses react to form a plasma is a reaction chamber). May teaches etching the nitride layer, silicon oxide layer, and substrate in a single dry plasma etch (column 7 lines 7-10). A dry plasma etch would include the group of fluorocarbons. Further, Sugishima teaches that silicon nitride, silicon oxide, and silicon can be etched

by the same chemistry when dry etching (column 5 lines 52-59). It would be obvious to one skilled in the art that a single etch chemistry offers time and economic savings over multiple etch chemistries due to purging and reflowing process steps. Further, the instant specification (pages 8-9) teach no criticality in using the same or different etch chemistries for the continued etching ("The same or alternate existing or yet to be developed chemistries could be utilized in continuing the etching to produce the figure 4 preferred embodiment construction.

Note that the specification contains no disclosure of either the critical nature of the claimed dimensions or of any unexpected results arising there from. Where patentability is said to be based upon particular chosen dimensions or upon another variable recited in the claim, the Applicant must show that the chosen dimensions are critical. In re Woodruff, 919 F.2d 1515, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

It would be obvious to one skilled in the requisite art at the time of the invention to modify Wolf by etching the silicon nitride layer, oxide material and into a semiconductive material using a single etch chemistry as taught by Lyons and May as a single etch chemistry would offer time and economic savings over multiple etch chemistries due to purging and reflowing process steps.

Ding teaches etching silicon oxide using fluorohydocarbon gasses in an etching chemistry containing ammonia (NH3, a source of hydrogen, abstract), thus the reactive components are ammonia and at least one fluorocarbon (including a flourohydrocarbon

as in claim 19, column 1 line 44). The etching is done in a magnetic field (magnetically enhanced plasma etching column 5 lines 13-15) as in claims 8-9, the preferred volumetric ratio of fluorohydrocarbon to ammonia is 2.5: to 7:1 (column 2 line 57) that encompasses limitations of 40:1 to 3:1 (taught in the instant specification, but not currently claimed). Ding's figure 3 also shows that volumetric ratios of 10+:1 were also used, thus encompassing the limitations of "no less than 9:1 (taught in the instant application, but not currently claimed). Ding also teaches using a combination of two fluorocarbons as in claim 14 (column 9 line 65-column 10 line 4) and (plural, at least two, column 6 lines 7, "mixtures thereof" suggesting three, as in claim 15). Ding (column 5 lines 45-550 teaches that the etching chemistry comprises fluorocarbon gasses, NH3 generating gas (ammonia), a carbon-oxygen gas, and an optional inert gas, thus teaching a chemistry which is has reactive gasses consisting of fluorocarbon gasses and ammonia. Further, (column 9 lines 17-18) Ding teaches that the flow rate of carbon-oxygen is lower than that of the fluorocarbon, thus the combination of fluorocarbon and ammonia is greater than 50% of the mix, hence essentially fluorocarbon gasses and ammonia.

Ding teaches volumetric ratios of 2.5:1 to 7:1 (column 7 line 15) and graphs 10+:1 (figure 3) and suggests altering the ratio for different profile etches. The instant application teaches ratios of 40:1 to 2:1, more preferably 40:1 to 3:1, and even more preferably 40:1 to 4:1, and further preferably no less than 6:1 and more preferably no less than 9:1 (all anticipated by Ding), and on page 8 "further preferably at least 20:1,

thus teaching no criticality between the ranges of 40:1 to 2:1. Thus the limitations in the claims are considered mere optimization. As taught by the instant specification, the ranges taught by Ding will work in the instant invention. These ranges are considered to involve routine optimization while it has been held to be within the level of ordinary skill in the art. As noted in re Aller, the selection of reaction parameters such as temperature and concentration would have been obvious:

> "Normally, it is to be expected that a change in temperature, or in concentration, or in both, would be an unpatentable modification. Under some circumstances, however, changes such as these may impart patentability to a process if the particular ranges claimed produce a new and unexpected result which is different in kind and not merely degree from the results of the prior art. Such ranges are termed "critical ranges and the applicant has the burden of proving such criticality.... More particularly, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation."
> In re Aller 105 USPQ233, 255 (CCPA 1955). See also In re Waite 77 USPQ 586 (CCPA 1948); In re Scherl 70 USPQ 204 (CCPA 1946); In re Irmscher 66 USPQ 314 (CCPA 1945); In re Norman 66 USPQ 308 (CCPA 1945); In re Swenson 56 USPQ 372 (CCPA 1942); In re Sola 25 USPQ 433 (CCPA 1935); In re Dreyfus 24 USPQ 52 (CCPA 1934).

One skilled in the requisite art at the time of the invention would have used any ranges or exact figures suitable to the method in the process of etching regarding rate flows and concentrations using prior knowledge, experimentation, and observation with the apparatus used in order to optimize the process and produce the etch profile structure desired to the parameters desired.

The instant application teaches that the gasses can be introduced into the chamber either simultaneously or successively (as in claim 48). As there is no teaching as to unexpected results of one method (sequence) to another, there is no criticality between

the two. Ding does not teach whether the gasses are introduced simultaneously or successively, but it is obvious that the method chosen must be one of the two. The examples only teach that the gasses are present.

It has been held that "[v]arying the details of a process, as by adding a step or splitting one step into two does not avoid infringement, where the processes are substantially identical or equivalent in terms of function, manner, and result. Universal Oil Products Co. v. Globe Oil and Refining Co., 322 U.S. 471, 61 USPQ 382 (1944); Ace Patents Corporation v. Exhibit Supply Co., 119 F.2d 349, 48 USPQ 667 (7th Cir. 1941); King-Seeley Thermos Co. v. Refrigerated Dispensers Inc., 354 F.2d 533, 148 USPQ 114 (10th Cir. 1965). Identity of the apparatus used for executing the processes is not material in itself. National Lead Company v. Western Lead Products Co., 324 F.2d 539, 139 USPQ 324 (9th Cir. 1963)." Excerpt from Matherson-Selig Co. v. Carl Gorr Color Card, Inc., 154 USPQ 265 (DC NIII 1967).
JP 2000-349071 teaches an apparatus for etching silicon, photoresists, and silicon nitride films using either CF4, CF4 and C5F8 (as in claim 52), or C5F8, with a nitrogen source and with or without CO2 gas. The use of C5F8 is preferred due to improved environmental results. Thus, using these fluorocarbons is well known in the art for etching these layers. The selection of a known material based on its suitability for its intended use supported a prime facie obviousness determination in Sinclair and Carroll., Inc. v. Interchemical Corp., 325 U.S. 327, 65 USPQ 297 (1945 "Reading a list and selecting a known compound to meet known requirements is no more ingenious than selecting the last piece to put in the last opening in a jig-saw puzzle." 65 USPQ at 301).

One skilled in the requisite art at the time of the invention would modify Ding, JP 2000-349071and Wolf by including C4F6 as one of the fluorocarbons as an etching gas because Ding and wolf teach fluorocarbons and C4F6 is an empirical formula for several fluorocarbon.

One skilled in the requisite art at the time of the invention would modify Ding, and Wolf by including multiple fluorocarbons in conjunction with ammonia as a hydrogen source and specifically C5F8 as taught by JP 2000-349071 to reduce environmental concerns, with reasonable expectation of producing a trench with better control of the etch profile angle (Ding column 1 line 55, Wolf page 552).

3. Claim 47 is rejected under 35 U.S.C. 103(a) as being unpatentable over Wolf (pages 40, 52-54, and 555-557) in view of Ding (US 5,814,563) and JP 200-349071, Sugushima (US4352724) and Lyons (US005930645A) or May (US005943585A) as applied to claim 16 above, and further in view of Lucent Technologies.

Wolf, Ding, Sugushima, and Lyons or May, teach all of the positive steps of claim 47 as recited above except for the use of a 193-nanometer photoresist. Ding (priority date 1996) uses a photoresist and gives as an example, a Riston photoresist. The release by Lucent Technologies (4/1997) announce a 193 nanometer photoresist for use in smaller and smaller designs in microelectronics (paragraph 3). As the trend in semiconductors is to decrease device size and increase density, it is obvious that one skilled in the art would alter a process to encompass new, known equipment for decreasing device size and increasing device density.

One skilled in the requisite art at the time of the invention would modify Ding by using a newer photoresist developed by Lucent Technologies with reasonable expectation of producing a pattern on a semiconductor with smaller device dimensions.

Response to Arguments

4. Applicant's arguments filed 8/25/04 have been fully considered but they are not persuasive.

The applicant argues that Wolf does not disclose or suggest utilizing a single etch chemistry to etch through an opening through silicon nitride, silicon oxide, and into semiconductive material. Nor does Wolf teach a single etch chemistry comprising ammonia and one or more fluorocarbon.

In response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). Wolf teaches an etch chemistry of a fluorocarbon and hydrogen to adjust the etch selectivity. Wolf is silent as to the source of the hydrogen. Ding teaches the use of ammonia as a source of hydrogen when etching with fluorocarbons. Wolf does not teach etching through an opening through silicon nitride, silicon oxide, and into semiconductive material. Lyons teaches this.

The applicant further argues that Lyons does not etch through silicon nitride, and therefore cannot be used as a reference. The claims do not recite silicon nitride, but

rather a layer comprising silicon nitride. Layer 24 of Lyons is a silicon oxy-nitride, and therefore a layer comprising silicon nitride. Lyons may be used as it reads on the claims.

The examiner argues that Sugishima teaches isotropic etching (although acknowledging the reference also teaches anisotropic etching. The applicant argues that although Sugishima teaches the same etchant may be used for silicon nitride, silicon, and silicon oxide, it is not taught to use the same etchant. However, it is noted that Lyons was used for this teaching.

The applicant argues that Wolf and Sugishima do not teach a processing gas of ammonia and a fluorocarbon to etch through silicon nitride, oxide, and semiconductive material. However, the rejection was made with Wolf, Sugishima, Lyons, and Ding and the material comprises silicon nitride, but is not limited to silicon nitride.

The applicant argues with respect to May, that nitride and substrate layers not covered by a photoresist are etched, but not by a single etch chemistry. The examiner disagrees. May teaches etching in "a dry plasma etch step". This suggests a single etch chemistry.

The applicant argues that Ding teaches a fluorocarbon gas and an ammonia generating gas, and a carbon-oxygen gas and not a processing gas consisting of ammonia and at

least one fluorocarbon. An ammonia generating gas reads on a gas consisting of ammonia, and the claims do not preclude additional gasses such as a carbon-oxygen gas.

The applicant further argues that JP071 does not teach or suggest processing gas consisting of ammonia and at least one fluorocarbon. The reference was not used to teach this.

The applicant argues that dependent claims 9, 14-15, 21, and 48-49 are allowable as they depend upon allowable base claim. However, the examiner maintains that claim 16 is not allowable as currently written.

The applicant argues that Lucent technologies is used to disclose the use of a 193 nanometer photoresist, but does not contribute to teaching a processing gas consisting of ammonia and at least one fluorocarbon. Lucent technologies was not used to teach or suggest this.

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to David S. Blum whose telephone number is (571)-272-1687) and e-mail address is David.blum@USPTO.gov .

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead Jr., can be reached at (571)-272-1702. Our facsimile

number all patent correspondence to be entered into an application is (703) 872-9306. The facsimile number for customer service is (703)-872-9317.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

David S. Blum

September 3, 2004